ESL-IC-13-10-55

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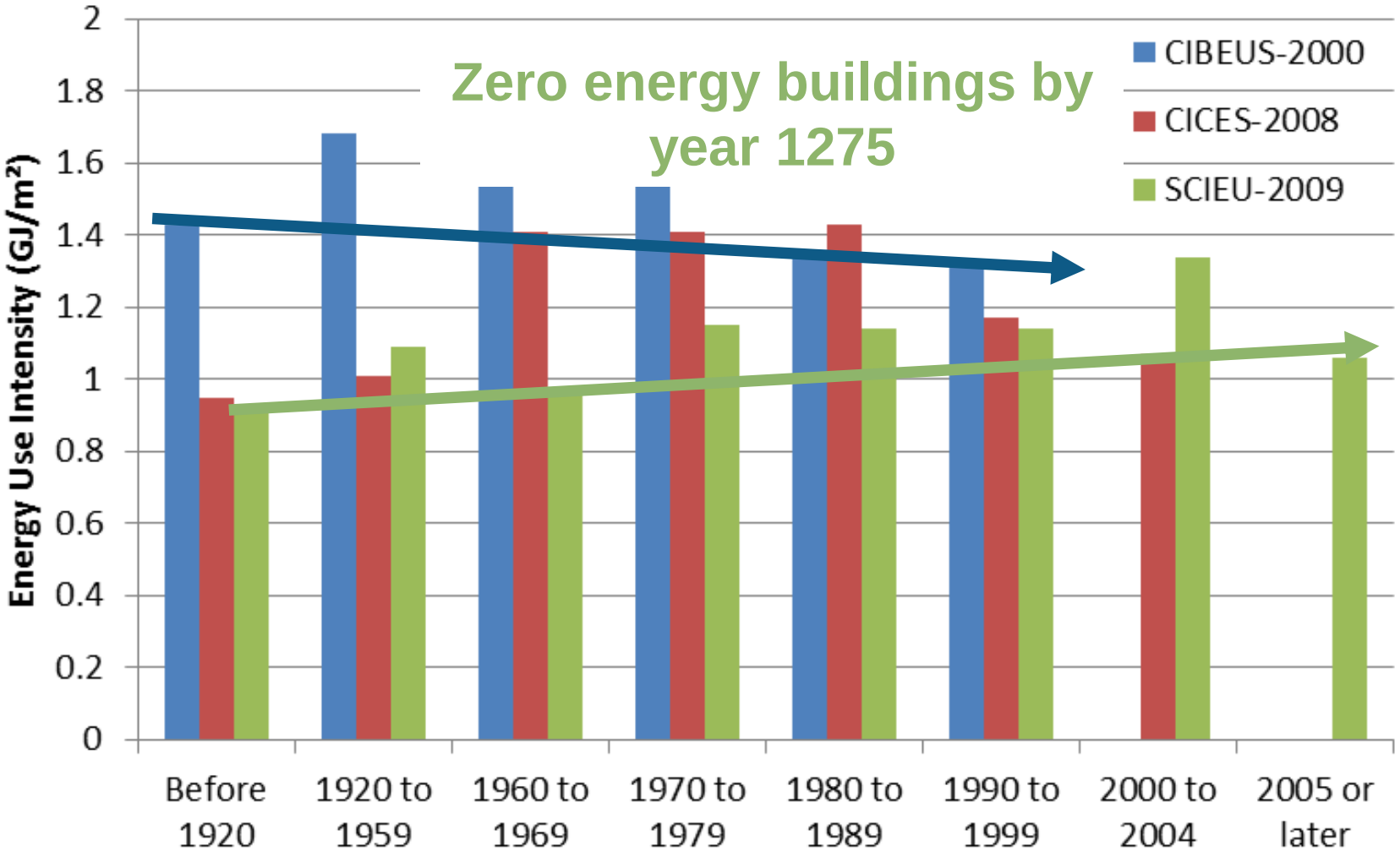
Mission Net-Zero:
Where Are We Now And How Do We Get There?

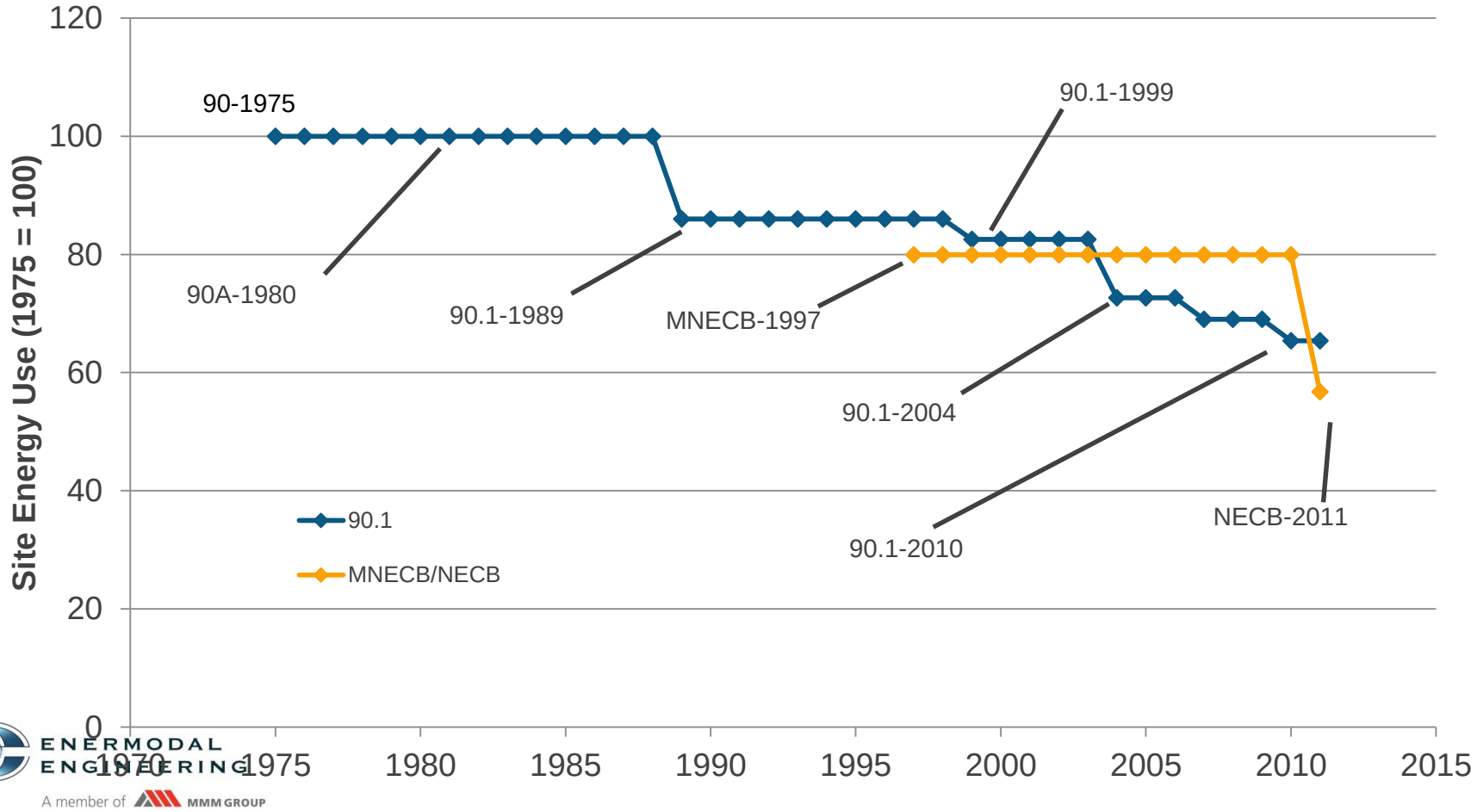
Stephen Carpenter
President, Enermodal, member of MMM Group

Proceedings of the 13th International Conference for Enhanced Building Operations, Montreal, Quebec, October 8-11, 2013

What is Energy Use of Current Cdn Buildings?



But Energy Codes Have Gotten Better…



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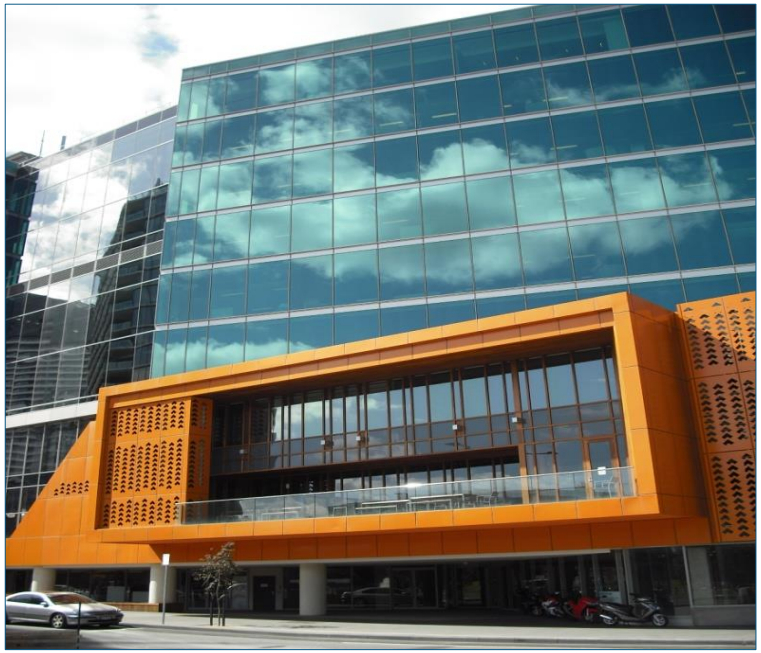
But Have Buildings….

1864
Province House, Charlottetown
R-4, 30% FWR

2013
Everywhere
R-3, 80%+ FWR



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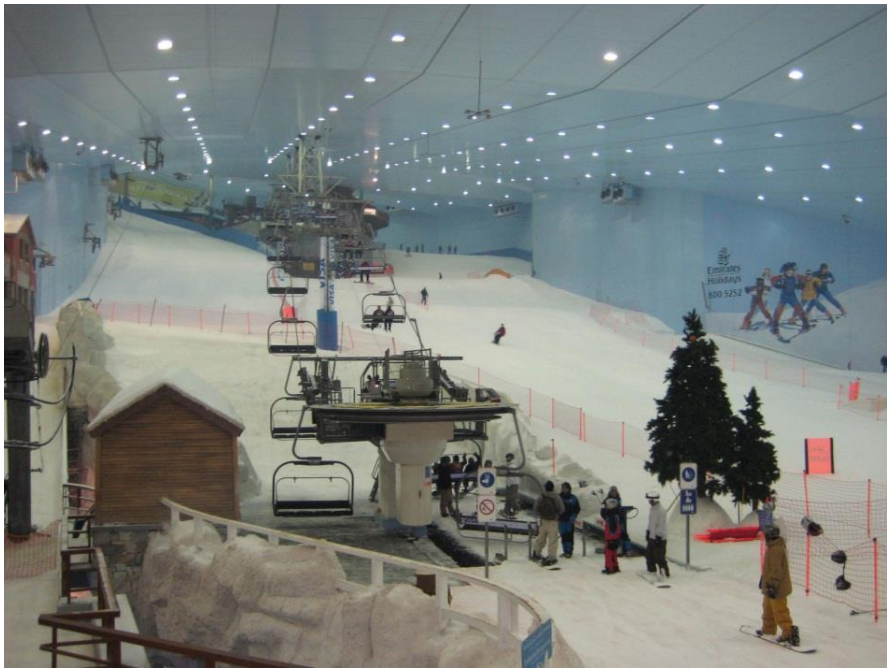
And The Systems…



Ski Dubai

Summer Design Temperature	44°C
Winter Low Temperature (average)	15°C

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Where Are We Today?

Building Type	ekWh/m^2
Warehouse	183
Schools	214
Retail	264
Offices	333
Hotel/Motel	375
Nursing Homes	433
Hospital	672
Grocery Stores	783

But we want net-zero….

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What is Net Zero?

- NREL defini
  - "offsets an al amount of s course of one year
- How many n

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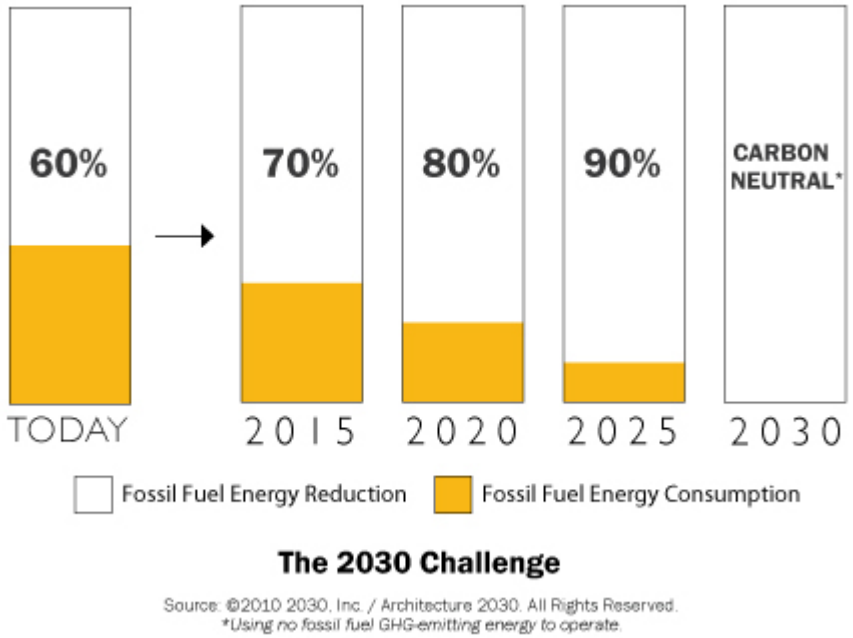
Can We Get There?

- **2030 Challenge sets increasingly stringent targets**



The 2030 Challenge

Source: ©2010 2030, Inc. / Architecture 2030. All Rights Reserved.
*Using no fossil fuel GHG-emitting energy to operate.

- **Can we achieve 80+% savings or <68 kWh/m^2 (for offices)?**

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Enermodal Head Office

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- Monitored energy use 68 kWh/m^2
- Energystar 100
- Triple LEED Platinum
- Total construction cost $250/ft^2

What are the steps to get to net-zero buildings?

Step 1: Get the Envelope Right

- **NO GLASS BOXES**

- **Orient building along east-west axis**
- **Narrow footprint with minimal interior spaces**
- **~40% window to wall ratio**
- **High performance glazing and framing**
- **Airtight envelope with minimal thermal bridging (more important than over-insulating)**

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The Benefits of Narrow Buildings (~13m)

- No one is more than 5m from a window – all spaces benefit from daylighting
- Simpler mechanical system (no interior vs perimeter)
- No interior columns

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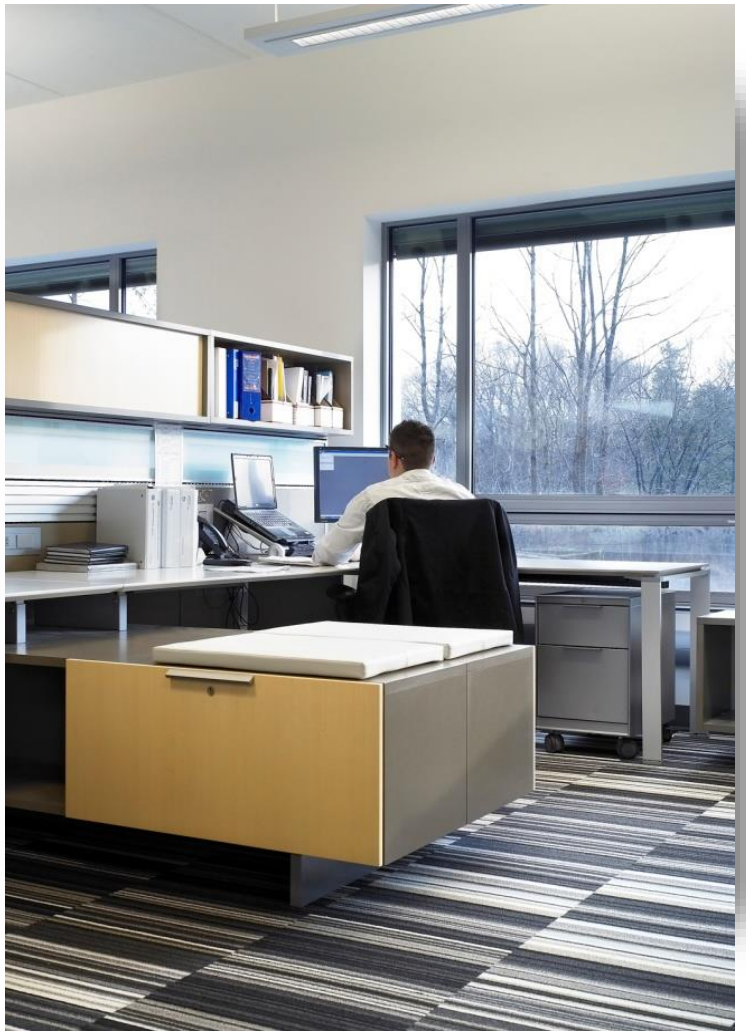
Step 2: Design for Maximum Occupant Satisfaction

- Give everyone a window, preferably operable
- Provide effective and/or automated glare control
- Design for 2-3 occupants per temperature control point



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Occupant Comfort Survey

	% Employees Satisfied	Percentile
General Building Satisfaction	100	100
Lighting	96	99
Cleanliness & Maintenance	95	95
Office Furnishings	95	99
Air Quality	95	99
Office Layout	89	96
Thermal Comfort	81	98
Acoustic Quality	49	70

2011 Living Building Award Winner

HOME | PARTNER LOGIN | CONTACT | SEARCH

CBE
CENTER FOR THE BUILT ENVIRONMENT

ABOUT US | RESEARCH | MEMBERSHIP | WHAT'S NEW

Livable Buildings

- 2011 Winners
  - Finalists
  - Jury
- 2010 Winners
- 2009 Winners
- 2008 Winners
- 2007 Winners
- Program Description
- Press

Livable Buildings Awards

A program to showcase buildings that excel in design, operation and occupant satisfaction.

In October of 2011 a jury of CBE Industry Partners selected Enermodal Engineering Headquarters as the winner of the Livable Buildings Award for 2011, and recognized the Kresge

Enermodal Engineering Headquarters, Livable Buildings Award Winner

Step 3: Separate Heating, Cooling and Ventilating Functions

- VAV Systems (including Under Floor) cannot deliver over 50% energy savings
- Use Dedicated Outdoor Air Systems (DOAS) for better air quality, performance and simplicity/control
- Many H/C options can be combined with DOAS:
  - Distributed heat pumps / Variable Refrigerant Flow
  - Radiant Heating and Cooling
  - Chilled Beams
  - DOAS VAV

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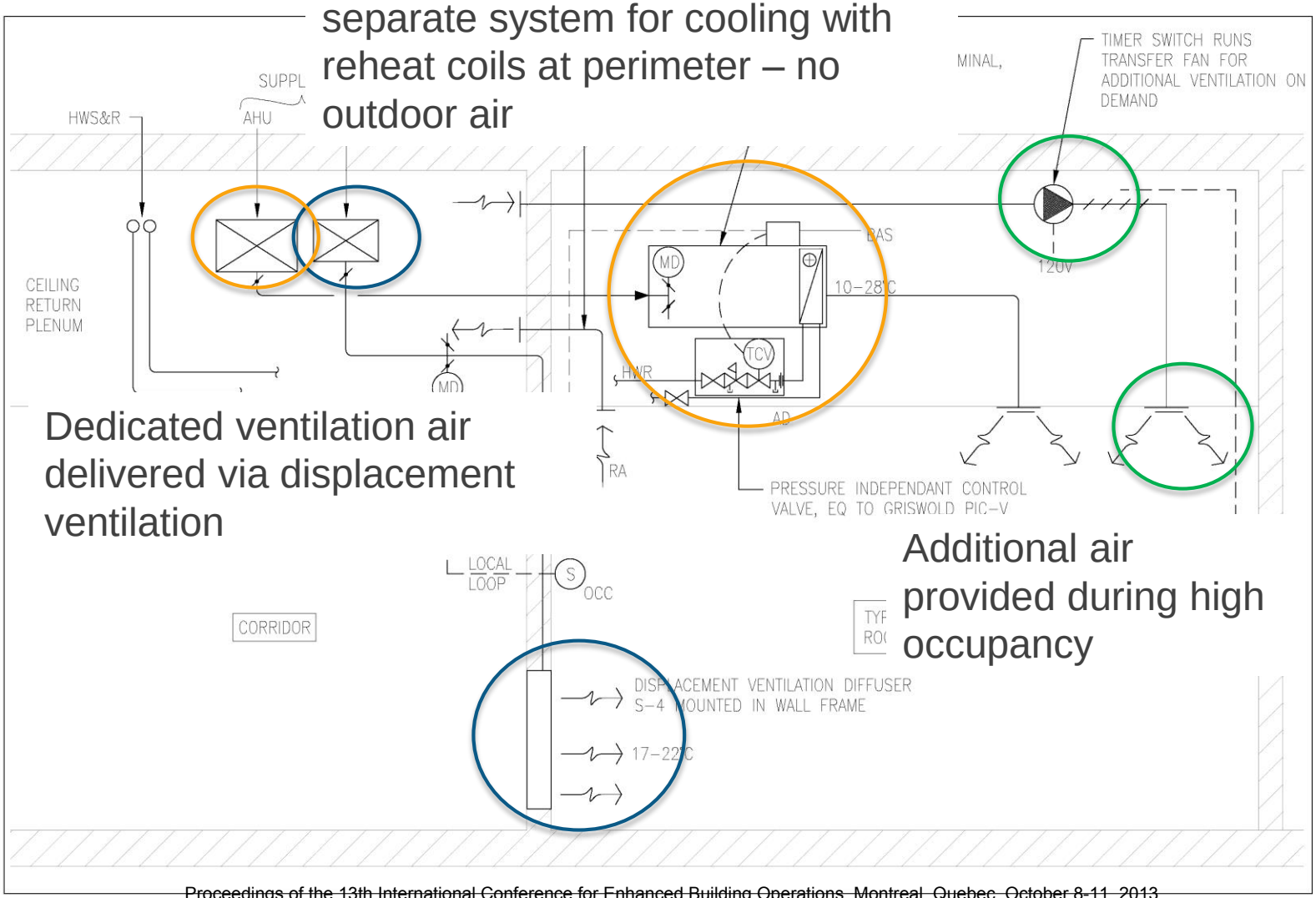
DOAS VAV Mechanical System

separate system for cooling with reheat coils at perimeter – no outdoor air



Dedicated ventilation air delivered via displacement ventilation

Additional air provided during high occupancy

DETAIL – TYPICAL ROOM HVAC
(HRV UNITS SIMILAR)

Nova Scotia Power HQ

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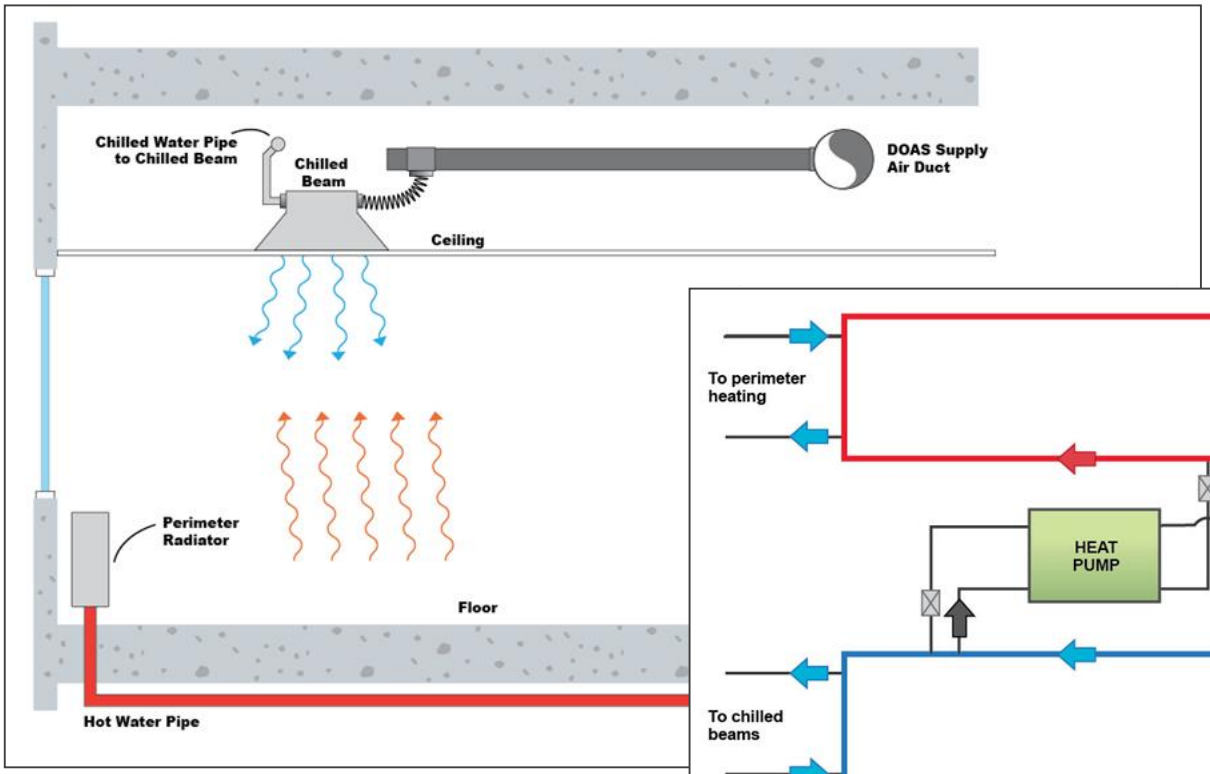
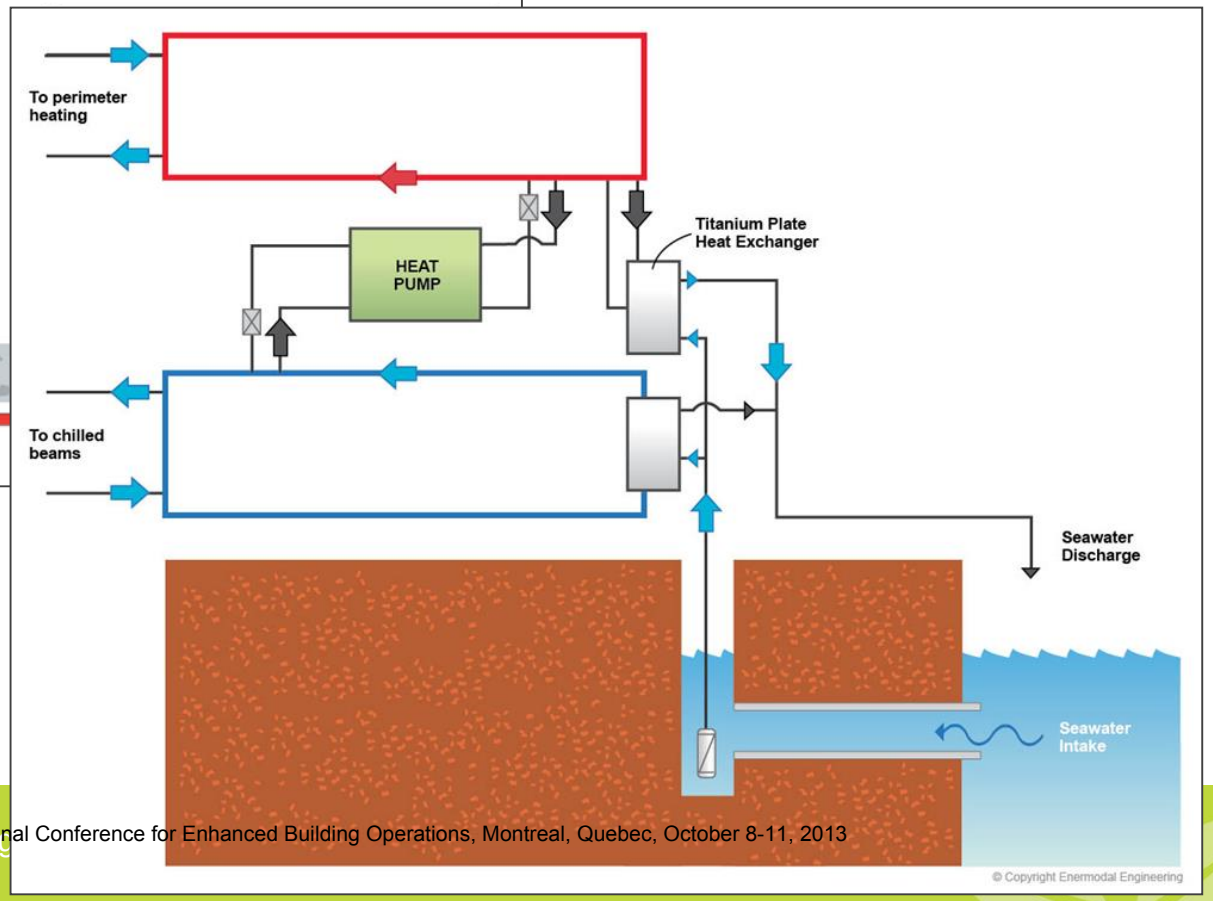
DOAS with Chilled Beams





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Step 4: Sweat the Little Stuff

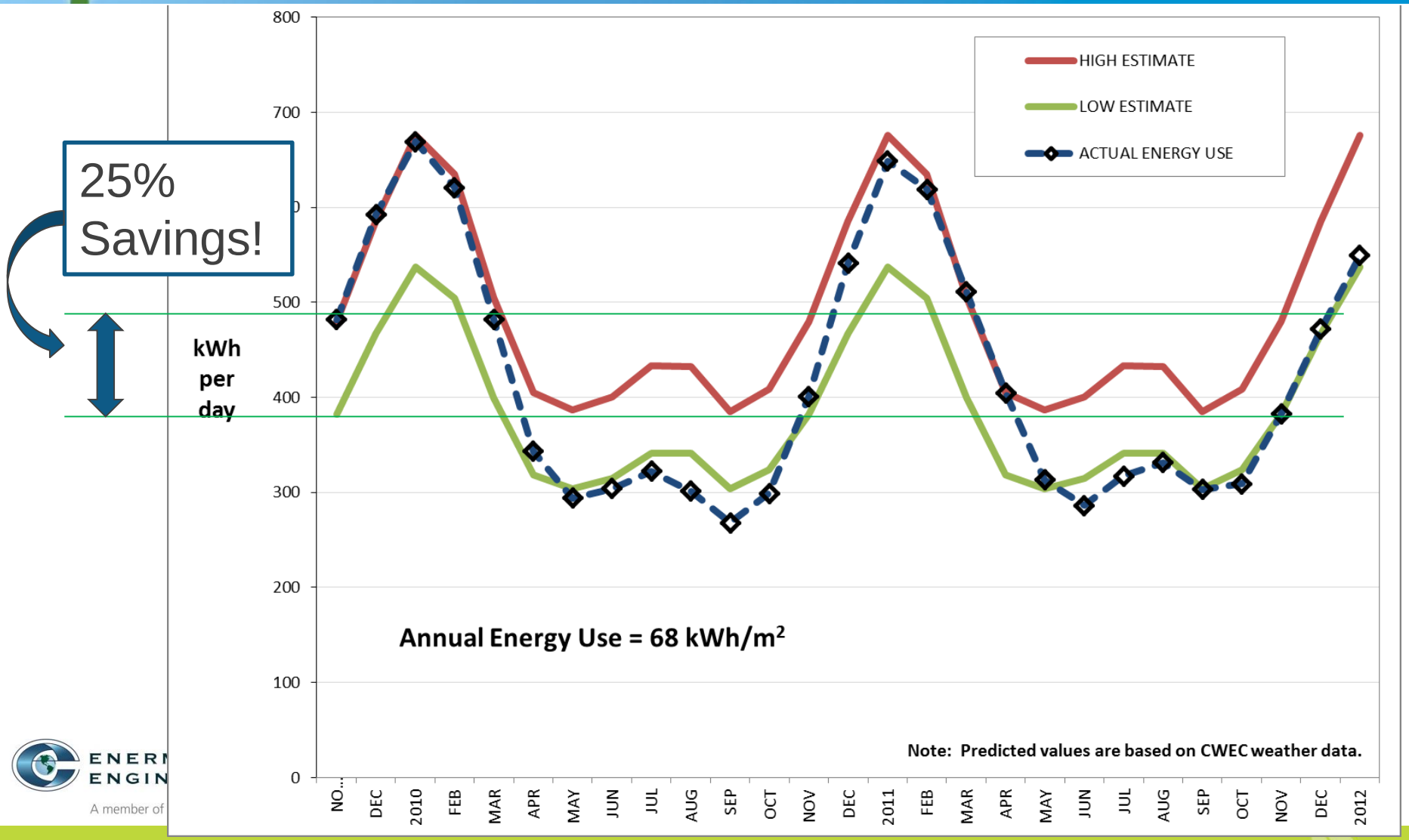
- **Right-size systems (most HVAC systems are twice as big as they need to be)**
- **Don't over-ventilate – ventilate efficiently and only when needed – use occupancy sensors to control!**

- **<u>Deal with plug loads</u>: computers, servers, elevators, equipment**

Step 5: You Manage What You Measure

- Get third-party review of design and commission all systems
- Measure energy use and compare to energy predictions by end-use
- Correct any discrepancies
- Engage employees – they use the energy

A Grander View Monitored Energy Use



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Step 6: Use Renewables at Building or Community Level

- 6 kW PV system will reduce energy use to under 60 kWh/m^2
- Or go with renewable district energy systems

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Okotoks Solar Community

Conclusions

- For net-zero need to re-think: building form, lighting systems, mechanical systems and ultimately design processes
- Design for energy use of 50 to 100 ekWh/m^2 and occupant satisfaction over 90%
- Commission, monitor and operate to hit and maintain targets
- You can do it if you try…

  and for the sake of the planet we have to try!

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